# Variational Principle in Photonic Crystals: analysis and predictions


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Photonic Crystals (PhC) are promising structures capable to show a Photonic Band Gap (PBG). This means that light with particular frequency cannot propagate through the PhC no matter what direction or polarization. This peculiarity is due to the refractive index periodicity present in the photonic crystal. A lot of applications and phenomena can be thought thanks to PhC: band-filters, resonant cavity[1], laser without inversion, spontaneous emission[2], planar antennas[3] and so on. According to the application, both 2D and 3D photonic crystals can be involved.
Unfortunately so far it was not possible to realize any applications with three dimensional PhC with any kind of technique. In the case of two photons lithography, for example, it is because of the low refractive index present in photoresist materials (around 1.5/1.6). It is, indeed, one of the fundamental parameters that play a key role to obtain a full band gap. Our intention is then to find out which are the theoretical relations between the geometry of the device (i.e., symmetries), the minimum refractive index request and the possibility to have a full band gap. One first step in such direction is to investigate on the relations between band gap and intensity light distribution inside the lattice by means of the Electromagnetic Variational Principle. In particular we are going to analyze the Diamond structure because of its unique characteristic to be very unique to realize band gap even with very low refractive index ratio. We'll present the behaviour shown by the dispersion relation of a diamond lattice when the refractive index is changed, and we'll explain it thanks to the Variational Principle. Then we'll make some prediction on the characteristic that an ideal structure should have to maximize the band gap.


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